A new species of *Terrisswalkerius* (Megascolecidae, Megascolecinae, Oligochaeta) from the Wet Tropics of Queensland

Barrie G. M. JAMIESON

Emeritus Professor, Department of Zoology and Entomology, School of Biological Sciences, University of Queensland, Brisbane Qld 4072, Australia. Email: b.jamieson@uq.edu.au

Keith R. McDONALD

Queensland Parks and Wildlife Service, PO Box 975, Atherton Qld 4883, Australia.

Samuel W. JAMES

Adjunct Associate Professor, Department of Biology, 143 Biology Building, University of Iowa, Iowa City, Iowa USA 52242–1324.

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ABSTRACT

A description is provided of a new species of the megascolecid earthworm genus *Terrisswalkerius*: *T. leichhardti* sp. nov. A revised generic definition and a key to species are given. ❐ *Earthworms; Clitellata; Megascolecidae; Megascolecinae; Terrisswalkerius leichhardti new species.*

In a taxonomic account of the species of the megascolecine genus *Diporochaeta* in Queensland, Jamieson (1976) drew attention to the widely disjunct distribution of the Queensland species relative to other, south-eastern Australian species of the genus. Subsequently (Jamieson, 1994), in a cladistic analysis of morphology, the 16 then known north Queensland species of *Diporochaeta* were transferred to the new genus *Terrisswalkerius*. Later, a molecular analysis using nuclear 28S rDNA and mitochondrial 12S and 16S rDNA (Jamieson *et al.* 2002) confirmed separation of *Terrisswalkerius* and its sister-genus *Fletcherodrilus* Michaelsen, 1891, from *Diporochaeta*. That finding was confirmed by Buckley *et al.* (2011) from analysis of mitochondrial 16S rRNA and 661 base pairs from the nuclear large subunit (28S) rRNA gene. They rejected transfer (Blakemore 2006, see also 2011) of the *Terriswalkerius* species used in their analysis to *Perionychella* and/or to *Diporochaeta* because *Terrisswalkerius* was a well-supported clade five nodes from these genera and inclusion would have made them even more polyphyletic. It is a phylogenetically and zoogeographically discrete genus although the anomalous position of *T. athertonensis* requires further investigation. A striking morphological distinction from these genera is the absence of accessory genital markings.

This account of a new species of *Terrisswalkerius* collected in the Australian Wet Tropics in January to March 2007 augments the monographic CDs of Jamieson (2000, 2001), for Megascolecinae. The specimens were collected as part of an ongoing study of molecular phylogeny of the Oligochaeta.

Terrisswalkerius Jamieson, 1994

Terrisswalkerius Jamieson, 1994: 158–159; 2000: 1344; 2001: 1344–1345.

Type-species. *Perichaeta canaliculata* Fletcher, 1887.

Diagnosis. Setae numerous (>14) per segment. Genital markings other than porophores bearing the female, male and spermathecal

pores, absent. A pair of combined pores of vasa deferentia and tubular or tubuloracemose prostates on XVIII. Last hearts in XII or XIII. Gizzard in V or VI (or VII?) (well developed); intestinal caeca and typhlosole absent. Extramural calciferous glands absent. Nephridia stomate exonephric holonephridia with or without bladders; their pores in straight or sinuous lines but never with regular alternation. Spermathecae 1 to 5 pairs, rarely unpaired midventral, always pretesticular, diverticulate; diverticulum usually single, uniloculate; rarely double, rarely multiloculate.

Distribution. Eastern Subregion, Torresian Division: the Wet Tropics of north eastern Queensland, from the Paluma Range, 19°S, near Townsville, north to the McIlwraith Range, at 13°44'S.

REVISED KEY TO SPECIES OF *TERRISSWALKERIUS*

1. a. Spermathecal pore unpaired, midventral in intersegmental furrows 7/8 and 8/9. (Differing from *Fletcherodrilus* in having paired spermathecae) ... *T. miseriae* Jamieson, 1997
– b. Spermathecal pores paired; if unpaired not restricted to 7/8 and 8/9 2

2. (1b) a. Spermathecal pores 5 pairs, in or shortly behind intersegmental furrows 4/5–8/9 3
– b. Spermathecal pores 1 to 4 pairs (rarely unpaired, midventral), in or shortly behind some of intersegmental furrows 4/5–8/9 .. 5

Spermathecal pores 5 pairs

3. (2a) a. Spermathecal pores in *a* or *b* lines. Last hearts in XIII. (Spermathecal duct very short.) ..... *T. grandis* (Spencer, 1900)
– b. Spermathecal pores median to *a* lines. Last hearts in XII. (Spermathecal duct at least one fourth length of ampulla) 4

4. (3b) a. Nephridial bladders absent ..... *T. phalacrus* (Michaelsen, 1916)
– b. Nephridial bladders present ..... *T. atavius* (Michaelsen, 1916)

5. (2b) a. Spermathecal pores in 4 intersegments, 5/6-8/9 or 4/5–7/8, paired or single 6
– b. Spermathecal pores 3 pairs or fewer . 10

Spermathecal pores in 4 intersegments

6. (5a) a. Spermathecal pores in 5/6–8/9, unpaired, midventral ... *T. mcdonaldi* Jamieson, 1994
– b. Spermathecal pores 4 pairs, in 4/5–7/8 or 5/6–8/9 7

7. (6b) a. Spermathecal pores 4 pairs, in 4/5–7/8 ..... *T. terrareginae* (Fletcher, 1890)
– b. Spermathecal pores 4 pairs, in 5/6-8/9 .. 8

8. (7b) a. Male pores well median of *a* lines ..... *T. millaamillaa* (Jamieson, 1976)
– b. Male pores in or lateral of *c* lines 9

9. (8b) a. Prostomium tanylobous, with wide dorsal tongue. (Peristomium short). Nephropores in straight series on each side ..... *T. erici* (Michaelsen, 1916)
– b. Prostomium epilobous or proepilobous; with longitudinal grooves which continue to the hind margin of the peristomium. Nephropores in an irregularly sinuous series, varying from far dorsally to far ventrally, on each side .... *T. kurauda* (Jamieson, 1976)

10. (5b) a. Spermathecal pores 3 pairs, in or shortly behind 4/5–6/7, 5/6–7/8, or 6/7–8/9 11
– b. Spermathecal pores 1 or 2 pairs, in some of 4/5–8/9 18

Spermathecal pores 3 pairs

11. (10a) a. Spermathecal pores 3 pairs, in 4/5–6/7 12
– b. Spermathecal pores 3 pairs, in or shortly behind 5/6–7/8 or 6/7–8/9..... 15

12. (11a) a. Spermathecal diverticulum clavate, shorter than ampulla.....13
– b. Spermathecal diverticulum long and tortuous. Spermathecal pores in vicinity of *d* to *e* lines 14

13. (12a) a. Spermathecal pores approximately in *c* lines. Male porophores partly formed by evagination of muscular prostate ducts ..... *T. carbinensis* Jamieson, 1997
– b. Spermathecal pores in or between *a* and *b* lines. Male porophores not formed by evagination of muscular prostate ducts ... *T. montislewisi* (Jamieson, 1976) (part.)

14. (12b) a. Spermathecal diverticulum longer than ampulla plus duct. (Spermathecal pores in *d* lines) . . . *T. barronensis* (Fletcher, 1886)

– b. Spermathecal diverticulum shorter than ampulla plus duct. (Spermathecal pores in *d–e* lines) . . . . . *T. raveni* (Jamieson, 1976)

15. (11b) a. Spermathecal pores immediately behind or in 5/6–7/8 . . . . . *T. covacevichae* Jamieson, 1994

– b. Spermathecal pores in 6/7–8/9 16

16. (15b) a. Male pores very close together, almost contiguous midventrally, on a common field or papilla . *T. athertonensis* (Michaelsen, 1916)

– b. Male pores well separated, between setal lines *a* and f, on a pair of papillae 17

17. (16b) a. Spermathecal diverticulum simple, shortly clavate *T. canaliculatus* (Fletcher, 1887)

– b. Spermathecal diverticulum composite, consisting of as many as 4 parallel conjoined tubes with terminal, knoblike seminal chambers; approximately as long as spermatheca . *T. oculatus* (Jamieson, 1976)

18. (10b) a. Spermathecal pores 2 pairs, in 4/5 and 5/6 or 5/6 and 6/7 19

– b. Spermathecal pores in 1 pair, in 6/7 or 7/8 or 8/9 21

Spermathecal pores 2 pairs

19. (18a) a. Spermathecal pores 2 pairs, in 5/6 and 6/7 20

– b. Spermathecal pores 2 pairs, in 4/5 and 5/6 . . . . . *T. windsori* Jamieson, 1995

– c. Spermathecal pores 2 pairs, in 7/8 and 8/9 . . . . . *T. moritzi* Jamieson, 2000

20. (19a) a. Male pores close together, in *b* lines . . . . *T. montislewisi* (Jamieson, 1976) (part.)

– b. Male pores widely separated, in setal lines 3-4 relative to XIX . *T. leichhardti* sp. nov.

Spermathecal pores 1 pair

21. (18b) a. Spermathecal pores 1 pair, in or shortly posterior to 8/9. Spermathecal diverticulum long and tortuous 22

– b. Spermathecal pores 1 pair, in 6/7 or 7/8 23

22. (21a) a. Spermathecal pores in setal lines c to *d* . . . . . *T. nashi* (Jamieson, 1976)

– b. Spermathecal pores in or median of setal lines *a* . . . . . *T. liber* Jamieson, 1994

23. (21b) a. Spermathecal pores 1 pair in 6/7 . . . . . *T. crateris* (Jamieson, 1976)

– b. Spermathecal pores in 7/8 24

24. (23b) a. Setal interval *ab* not narrower than other intervals. Nephridia with diverticulate bladders . . . . . *T. mcilwraithi* Jamieson, 1997

– b. Setal interval *ab* narrower than other intervals. Nephridia lacking bladders . . . . . *T. blounti* (Jamieson, 1976)

Terrisswalkerius leichhardti sp. nov.
(Figs 1A–C, 2A, B)

Etymology. Named after the explorer, Ludwig Leichhardt.

Material Examined. Holotype: Tinaroo Range, 17°05′34″S 145°35′13″E, altitude 1120 m, on ridge dividing headwaters of Kauri and Emerald Creeks catchments, both creeks flowing eventually into Barron River; 100 metres from Mt Haig-Kauri Creek road junction, complex notophyll vine forest in cloudy wet and moist uplands on Mareeba granite; clitellate specimen, PFA fixation, W1, B.G.M. Jamieson and K.R. McDonald, 25 Jan 2007, QM G231053.

Paratypes: Holotype locality. 100% EtOH or PFA fixation, B.G.M. Jamieson and K.R. McDonald, 25 Jan 2007, QM G231291–231293; Danbulla National Park, site 2, 17°05′34″S 145°35′15″E, Mt. Haig turnoff, Tinaroo Range, notophyll vine forest on granite hills, 5 specimens, two strongly clitellate, formalin/ethanol, K.R. McDonald, 27 Mar 2007, QM G231054–231058; Kauri Creek Road, 17°07′21″S 145°36′27″E, notophyll vine forest on granite PFA fixation, B.G.M. Jamieson and K.R. McDonald, 25 Jan 2007, QM G231294.

Diagnosis. See Remarks.

Description. Length 66–70 mm. Width (midclitellar) 3.6 mm (Holotype). Segments 120 (H). In alcohol (ex PFA) dorsally pigmented purplish brown with pale grey clitellum; in life with an almost black forebody. Prostomium (Fig. 1B) with form of very broad wedge only very slightly impinging on peristomium (slightly epilobous, closed), with conspicuous middorsal groove (canalicula) which extends to posterior limit of peristomium; faint midventral groove or at least

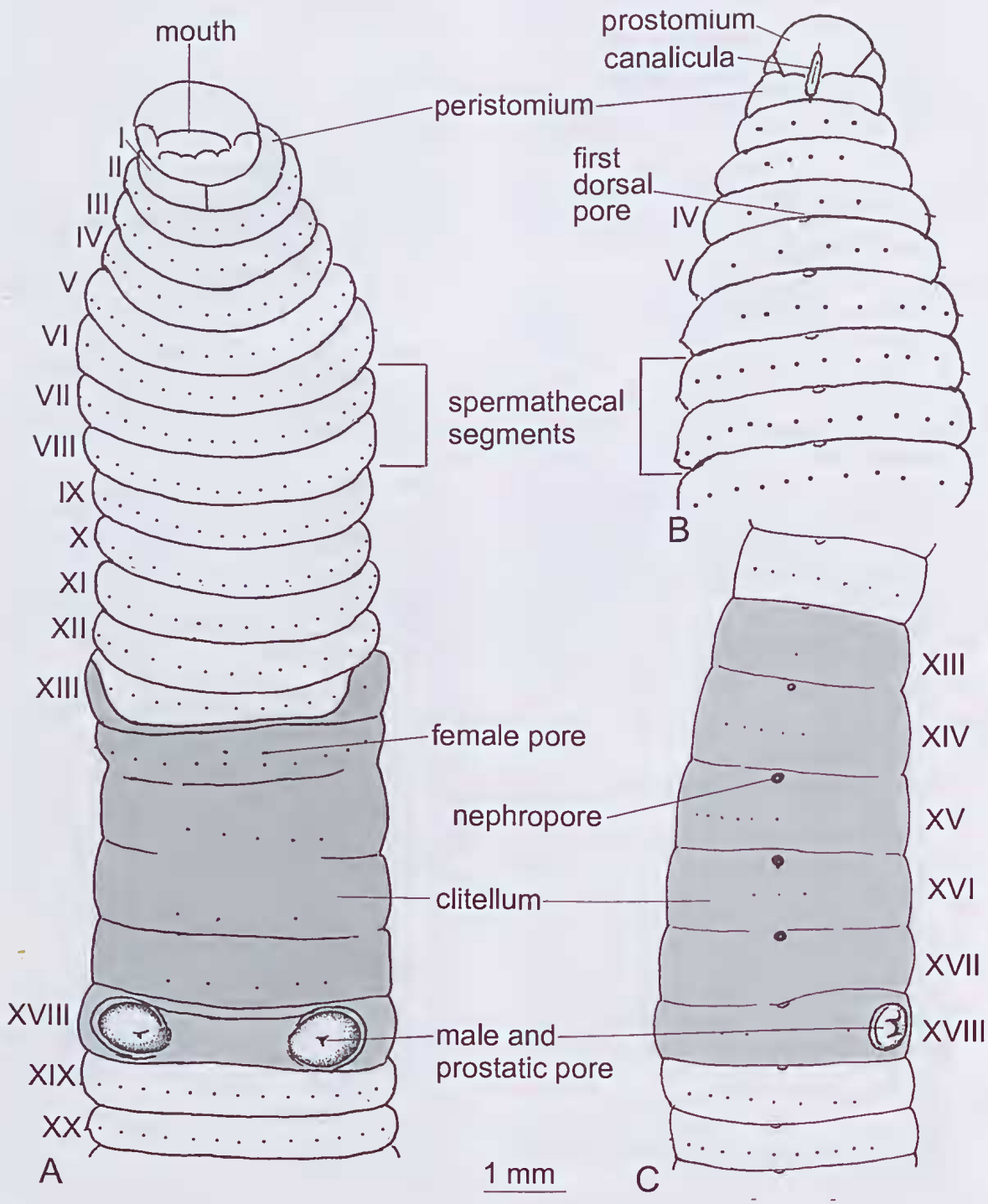

FIG. 1. *Terrisswalkerius leichhardti* sp. nov. **A**, Ventral view of male genital field and forebody; **B**, Dorsal view of prostomium and anterior segments; **C**, Semi-lateral view, showing nephropores. Holotype QM G231053.

pigmented line throughout body; peristomium not appreciably shorter than first setigerous segment, bisected by midventral groove. First dorsal pore 4/5 (vestigial), 5/6 patent. Setae 26 in XII (H); closely and subequally spaced; *ca.* 0.26 mm apart; setae absent in XVIII between male pores; *a* lines becoming slightly irregular posteriorly; *z* lines irregular in forebody, more so in hind body; ventral and dorsal breaks not appreciable. Nephropores (Fig. 1C) in single, straight lateral series on each side, especially prominent, as dark orifices, on clitellum; in setal lines 7 preclitellar and 9 on clitellum.

Clitellum annular, dorsally XIII–XVIII (= 6 segments), but ventrally with a wide interruption in XIII. Male pores (Fig. 1A, C) in approximately setal lines 3 of XVIII relative to segment XVII or setal lines 3–4 relative to XIX, on very strongly protuberant domed papillae, each insunken at the pore, and with circumferential grooves; the pores 2.2 mm; 0.2 body circumference apart. Genital markings absent. Female pores not discernible with certainty, a pair shortly anterior to setae *a* of XIV. Spermathecal pores not visible externally; from internal examination, 2 pairs, in 5/6 and 6/7, in setal lines 6.

Septa 11/12–13/14 the strongest, moderately thickened. Last hearts in XII. Supraoesophageal vessel well developed. Gizzard large and firmly muscular, barrel-shaped with anterior rim, in VI(?), but its posterior end at level of 10/11. Intestinal origin XVII, with wide expansion.

Nephridia stomate, vesiculate holonephridia; a bladder examined in XXVI with a lateral diverticulum. Sperm funnels large and iridescent, in X and XI, embedded in flocculent (sperm?) masses; testis-sacs absent; seminal vesicles in IX and XII racemose, those in IX by far the larger; those in XII subspheroidal with tapering median portion, so as to appear club-shaped; a similar pair ("pseudovesicles" but probably functional) on anterior wall of XIII. Ovaries not discernible but oviducal funnels on posterior wall of XIII. Prostates (Fig. 2B) elongate racemose in appearance, in XVIII–XXII (right), –XXIII (left); incised by septa (tubuloracemose?); muscular duct long, sinuous, widening ectalwards but

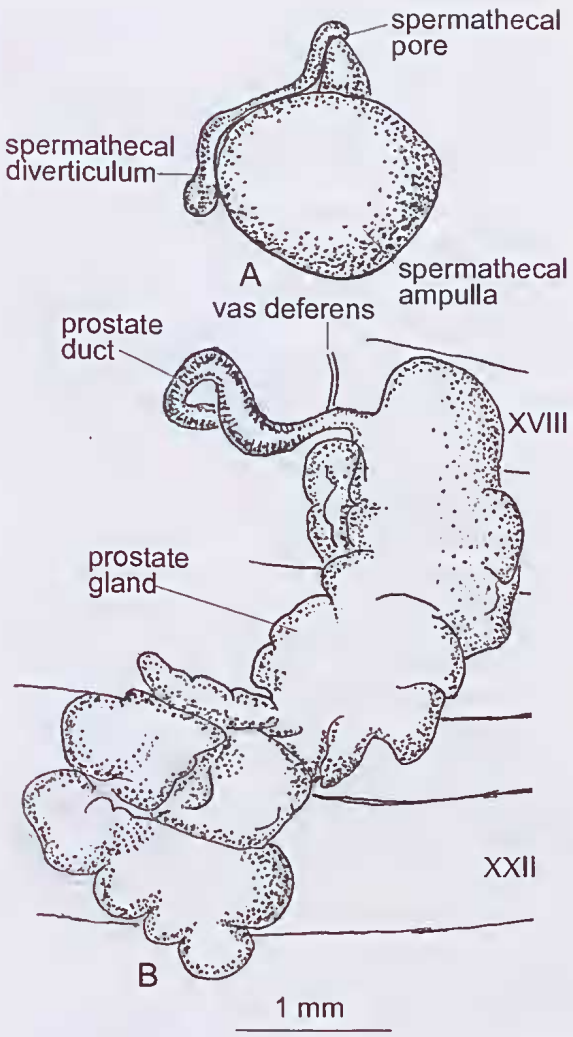

FIG. 2. *Terrisswalkerius leichhardti* sp. nov. **A**, Right posterior spermatheca, of VII; **B**, Right prostate. Holotype QM G231053.

widest at about midlength; joined ectal of gland by vas deferens; region of duct between this junction and gland with less muscular sheen than remaining more ectal, longer portion; ectal region coiled in circle over male porophore; tubuloracemose condition confirmed in further, aclitellate material where prostates are thin and straplike, though with some low superficial nodules. Penial setae absent. Spermathecae (Fig. 2A), 2 pairs, opening anteriorly in VI and VII; ampulla spheroidal, duct slender, tapering to pore; diverticulum (inseminated)

single, clavate, uniloculate, with long sinuous duct uniting with spermathecal duct at body wall; size approximately uniform; length of right spermatheca of VII = 1.4 mm, ratio of total length: length duct = 2.5; ratio length: length diverticulum *ca.* = 0.9; length diverticulum = 1.5 mm.

Remarks. The species of *Terrisswalkerius* most closely resembling *T. leichhardti* in general anatomy are those which, like it, have only two pairs of spermathecal pores, *viz. T. windsori*, (4/5 and 5/6), *T. moritzi* (7/8 and 8/9) and *T. montislewisi* (5/6 and 6/7 but usually in 4/5 also). Of these, *T. montislewisi* is the most similar but *T. leichhardti* differs from it, *inter alia*, in the slightly epilobous not tanylobous prostomium; the smaller number of setae, having 26 as contrasted with 32–42 in XII; anterior extension of the clitellum onto XIII; the wider separation of the prostatic porophores and their pores; the more elongate, tubuloracemose, prostates; and the greater length of the spermathecal diverticulum relative to the ampulla.

Terrisswalkerius leichhardti from the Danbulla site has been included as *T.* sp., in a molecular analysis of earthworm phylogeny by James and Davidson (2012). It was the only representative of the genus. The GenBank accession numbers for this species are HQ728886 (18S), HQ728974 (28S) and JF267897 (16S).

Barcoding. DNA barcoding is the use of a standardised region of 658 bp of the mitochondrial gene cytochrome c oxidase I (COI) for species discrimination (Hebert *et al.*, 2003). This was performed at the Canadian Centre for DNA Barcoding using the BOLD platform and laboratory procedures (BOLD, http://www.barcodinglife.org; Ratnasingham & Hebert 2007). We used a specimen from the holotype locality and one from Danbulla. Additional sequences from the holotype locality are on the BOLD database and can be retrieved by using the sequences given here as queries.

EW-SJ-929 Jamieson BGM and McDonald K 25/1/07 Australia Queensland Tinaroo Range, near Mt. Haig-Kauri Creek road jct, in notophyll vine cloud forest, 17°05′34″S 145°35′13″E (Holotype locality).

>EWSJA290-08 | EW-SJ-929 | *Terrisswalkerius leichhardti*

CACACTATACTTCATTTTAGGTGTTTGAGCTG
GAATAGTTGGGGTTGGGATAAGACTCCTA
ATTCGAATTGAGCTGAGGCAGCCAGGTG
CATTCTTAGGGAGCGACCAACTATACAATA
CAATTGTGACAGCCCACGCTTTTCTAATA
ATTTTCTTTTTAGTTATGCCAGTATTTATTGGAG
GATTTGGAAATTGATTATTACCACTTATATTA
GGGGCCCCCGACATGGCATTCCCACGACTAAT
AATATAAGATTTTGACTCCTGCCGCCCT-
CACTAATCTTATTAGTATCCTCTGCTGCC
GTAGAAAAAGGTGCTGGAACAGGGT-
GAACTGTCTATCCCCCCCTTAGCAA
GAAATATCGCCCATTCTGGGCCCT
CAGTAGACTTAGCAATTTTTTCTCTTCATT
TAGCAGGAGCCTCATCAATTTTGGGGGC
AATCAACTTTATTACCACAGTAATTAA-
CATACGATGATCGGGGTTACGACTAGAGC
GAGTCCCCCTATTTGTTTGAGCTGTGGTTAT
TACAGTAGTTTTGCTGCTACTATCTCTCCCAGT
GCTTGCTGGGGCCATCACTATATTATTA
ACCGATCGCAATCTAAACACATCTTTTTTT
GACCCTGCAGGTGGGGGGGACCCAATTT
TATACCAGCACTTATT-

EW-SJ-903 McDonald K 27/3/07 Australia Queensland Danbulla National Park, Tinaroo Range, notophyll vine forest on granite hills, 17°05′34″S 145°35′15″E (Paratype locality).

>EWSJA264-08 | EW-SJ-903 | *Terrisswalkerius leichhardti*

CACACTATACTTCATTTTAGGTGTTTGAGCTG
GAATAGTTGGGGTTGGGATAAGACTCCTA
ATTCGAATTGAGCTGAGGCAGCCAGGTG
CATTCTTAGGGAGCGACCAACTATACAATA
CAATTGTGACAGCCCACGCTTTTCTAATA
ATTTTCTTTTTAGTTATGCCAGTATTTATTGGAG
GATTTGGAAATTGATTATTACCACTTATACTA
GGGGCCCCCGACATGGCATTCCCACGACTA
AATAATATAAGATTTTGACTCCTGCCGCCCT
CACTAATCTTATTAGTATCCTCTGCTGCCG
TAGAAAAAGGTGCTGGAACAGGGTGAACT
GTCTATCCCCCCTTAGCAAGAAATATC
GCCCATTCTGGGCCCTCAGTAGACTTA
GCAATTTTTTCTCTTCATTTAGCAGGAGCCT
CATCAATTTTGGGGGCAATCAACTTTATTAC
CACAGTAATTAACATACGATGATCGGGGT

TACGACTAGAGCGAGTCCCCCTATTTGTTT
GAGCTGTGGTTATTACAGTAGTTTTGCTGC
TACTATCTCTCCCAGTGCTTGCTGGGGCCAT
TACTATATTATTAACCGATCGCAATCTAAACA
CATCTTTTTTTGACCCTGCAGGTGGGGGGGACC
CAATTTTATACCAGCACTTATT-

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